

## **B. AMENDMENTS TO THE CLAIMS**

This listing of claims will replace all prior versions, and listings, of claims in the application:

### **Listing of Claims:**

1. (original) A method for determining a two phase flow rate of a fluid mixture through a vessel, said fluid mixture comprising at least a first fluid component characterized by a first phase and a second fluid component characterized by a second phase, the method comprising:
  - A. performing a tomography measurement of said fluid mixture flowing through said vessel so as to determine a ratio  $\rho$  between said first component and said second component within said fluid mixture;
  - B. obtaining a first approximate flow measurement and a second approximate flow measurement by using a first and a second transducer sensor to transmit a wave through said fluid mixture and detect the transmitted wave; and
  - C. computing said two phase flow rate of said fluid mixture as a known function of said ratio  $\rho$ , said first and second flow measurements, and the direction and speed of transmission of said wave.
2. (original) A method in accordance with claim 1, wherein said tomography measurement comprises an ECT (Electrical Capacitance Tomography) measurement.
3. (original) A method in accordance with claim 1, wherein the step of determining said ratio of said first component to said second component comprises the step of measuring a distribution of dielectric permittivity within said vessel.
4. (original) A method in accordance with claim 3, wherein the step of measuring a distribution of dielectric permittivity within said vessel comprises measuring

the electrical capacitances between one or more pairs of electrodes placed around the periphery of a capacitance tomography unit.

5. (original) A method in accordance with claim 1, wherein at least one transducer sensor comprises an ultrasound sensor, and wherein said wave comprises an ultrasound wave.

6. (original) A method in accordance with claim 1, wherein said at least one transducer sensor comprises:

- a) a first ultrasound sensor for providing said first flow measurement, and
  - b) a second ultrasound sensor for providing said second flow measurement, and
- wherein said wave comprises a first ultrasound wave propagating at an angle with respect to the direction of flow of said fluid mixture, and a second ultrasound wave propagating at another angle with respect to the direction of flow of said fluid mixture.

7. (original) A method in accordance with claim 6, wherein said first ultrasound sensor comprises a first ultrasound transmitter for generating said first ultrasound wave and transmitting it through said fluid mixture, and a first ultrasound receiver for receiving said transmitted ultrasound wave; and  
wherein said second ultrasound sensor comprises a second ultrasound transmitter for generating said second ultrasound wave and transmitting it through said fluid mixture, and a second ultrasound receiver for receiving said transmitted ultrasound wave.

8. (original) A method in accordance with claim 1, wherein said transducer sensor comprises a pressure sensor, and said wave comprises a pressure wave.

7. (canceled)

8. (canceled)

9. (original) A method for determining a two phase flow rate of a fluid mixture through a vessel, said fluid mixture comprising at least a first fluid component characterized by a first phase and a second fluid component characterized by a second phase, the method comprising:

- A. performing a tomography measurement of said fluid mixture flowing through said vessel, so as to determine a concentration ratio  $\rho$  of said first component to said second component in said fluid mixture;
- B. transmitting a first ultrasonic wave through said fluid mixture, and measuring the speed and direction of propagation of said first ultrasonic wave;
- C. transmitting a second ultrasonic wave through said fluid mixture, and measuring the speed and direction of propagation of said second ultrasonic wave; and
- D. computing said two phase flow rate of said fluid mixture using a known relationship between said two phase flow rate, said ratio  $\rho$ , and said speed and direction of propagation of each ultrasonic wave relative to the direction of flow of said fluid mixture.

10. (original) A method in accordance with claim 9, wherein the direction of propagation of said first ultrasonic wave makes an angle  $[\pi/2 - \theta]$  with respect to the direction of flow of said fluid mixture;

wherein the direction of propagation of said second ultrasonic wave makes an angle  $[\pi/2 + \theta]$  with respect to the direction of flow of said fluid mixture; and

wherein said known relationship is given by:

$$v = \frac{\sin(\theta)}{2} \cdot (u_1 - u_2)$$

where

$v$  is said two phase flow rate of said fluid mixture ;

$u_1$  is said first approximate flow rate; and

$u_2$  is said second approximate flow rate.

11. (original) A method in accordance with claim 10,

wherein said first approximate flow rate  $u_1$  is given by:

$$u_1 = c_{mix} + \frac{1}{\sin(\theta)} v;$$

further wherein said second approximate flow rate  $u_2$  is given by:

$$u_2 = c_{mix} - \frac{1}{\sin(\theta)} v;$$

further wherein  $c_{mix}$  is the speed of sound within the fluid mixture, and is given by:

$$c_{mix} = c_{first} \cdot \rho + c_{second} \cdot (1 - \rho),$$

where

$c_{first}$  is the speed of sound within said first fluid component,

$c_{second}$  is the speed of sound within said second fluid component,

and  $\rho$  is said concentration ratio of said first component to said second component.

12. (original) A method in accordance with claim 9, wherein each of said first and second phases comprises at least one of: a solid; a liquid; and a gas.

13. (original) A system for measuring a two phase flow rate of a fluid mixture flowing through a vessel, said fluid mixture containing at least a first component characterized by a first phase, and a second component characterized by a second phase, the system comprising:

- A. a tomography system for determining the concentration ratio between said first component and said second component within said fluid mixture;
- B. a first sensor for providing a first approximate flow measurement for said fluid mixture;
- C. a second sensor disposed at a known orientation relative to said first sensor, for providing a second flow measurement for said fluid mixture; and
- D. a processor for computing the two phase flow rate of said fluid mixture using said concentration ratio, said first flow measurement, and said second flow measurement; wherein said two phase flow rate is related to said concentration ratio and to said first

and second flow measurements by a known relationship.

14. (original) A system in accordance with claim 13, wherein said first and second sensors each comprise:

- a. a transmitter for transmitting a wave through said fluid mixture; and
- b. a receiver for detecting said transmitted wave.

15. (original) A system in accordance with claim 14, wherein said two phase flow rate is a function of the direction and speed of transmission of said energy.

16. (original) A system in accordance with claim 13, wherein said first and said second sensors comprise at least one of: an ultrasound sensor; a pressure sensor; and a thermal sensor.

17. (original) A system in accordance with claim 14, wherein said energy comprises at least one of: a) an ultrasound wave; b) a pressure wave; and c) a thermal wave.

18. (original) A system in accordance with claim 13, wherein

a) said first sensor comprises a first ultrasound sensor for providing said first flow measurement;

b) said second sensor comprises a second ultrasound sensor for providing said second flow measurement; and

wherein said energy comprises a first ultrasound wave propagating at an angle with respect to the direction of flow of said fluid mixture, and a second ultrasound wave propagating at another angle with respect to the direction of flow of said fluid mixture.

19. (original) A system in accordance with claim 18, wherein the direction of propagation of said first ultrasonic wave makes an angle  $[\pi/2 - \theta]$  with respect to the direction of flow of said fluid mixture;

wherein the direction of propagation of said second ultrasonic wave makes an angle  $[\pi/2 + \theta]$  with respect to the direction of flow of said fluid mixture; and  
 wherein said known relationship is given by:

$$v = \frac{\sin(\theta)}{2} \cdot (u_1 - u_2),$$

where

$v$  is said two phase flow rate of said fluid mixture ;

$u_1$  is said first approximate flow rate; and

$u_2$  is said second approximate flow rate.

20. (original) A system in accordance with claim 19,  
 wherein said first approximate flow rate  $u_1$  is given by:

$$u_1 = c_{mix} + \frac{1}{\sin(\theta)} v;$$

further wherein said second approximate flow rate  $u_2$  is given by:

$$u_2 = c_{mix} - \frac{1}{\sin(\theta)} v;$$

further wherein  $c_{mix}$  is the speed of sound within the fluid mixture, and is given by:

$$c_{mix} = c_{first} \cdot \rho + c_{second} \cdot (1 - \rho),$$

where

$c_{first}$  is the speed of sound within said first fluid component,

$c_{second}$  is the speed of sound within said second fluid component,

and  $\rho$  is said concentration ratio of said first component to said second component.

21. (original) A system in accordance with claim 18, wherein said first and second ultrasound sensor each comprises: an ultrasound transmitter for generating an ultrasound wave and transmitting it through said fluid mixture, and an ultrasound receiver for receiving said ultrasound wave.

22. (original) A system in accordance with claim 13, wherein said tomography

system comprises an ECT (Electrical Capacitance Tomography) system for providing a distribution of dielectric permittivity within said vessel by measuring the electrical capacitances between one or more pairs of electrodes placed around said vessel.

23. (original) A system in accordance with claim 13, wherein said vessel is characterized by a tubular configuration.

24. (original) A system in accordance with claim 13, wherein said vessel includes at least one bend.

25. (new) A method in accordance with claim 1, wherein said vessel is characterized by a tubular configuration, and wherein transducer sensor is disposed on the surface of said vessel.

26. (new) A method in accordance with claim 1, wherein said transducer sensor comprises a thermal sensor, and said wave comprises a thermal wave.